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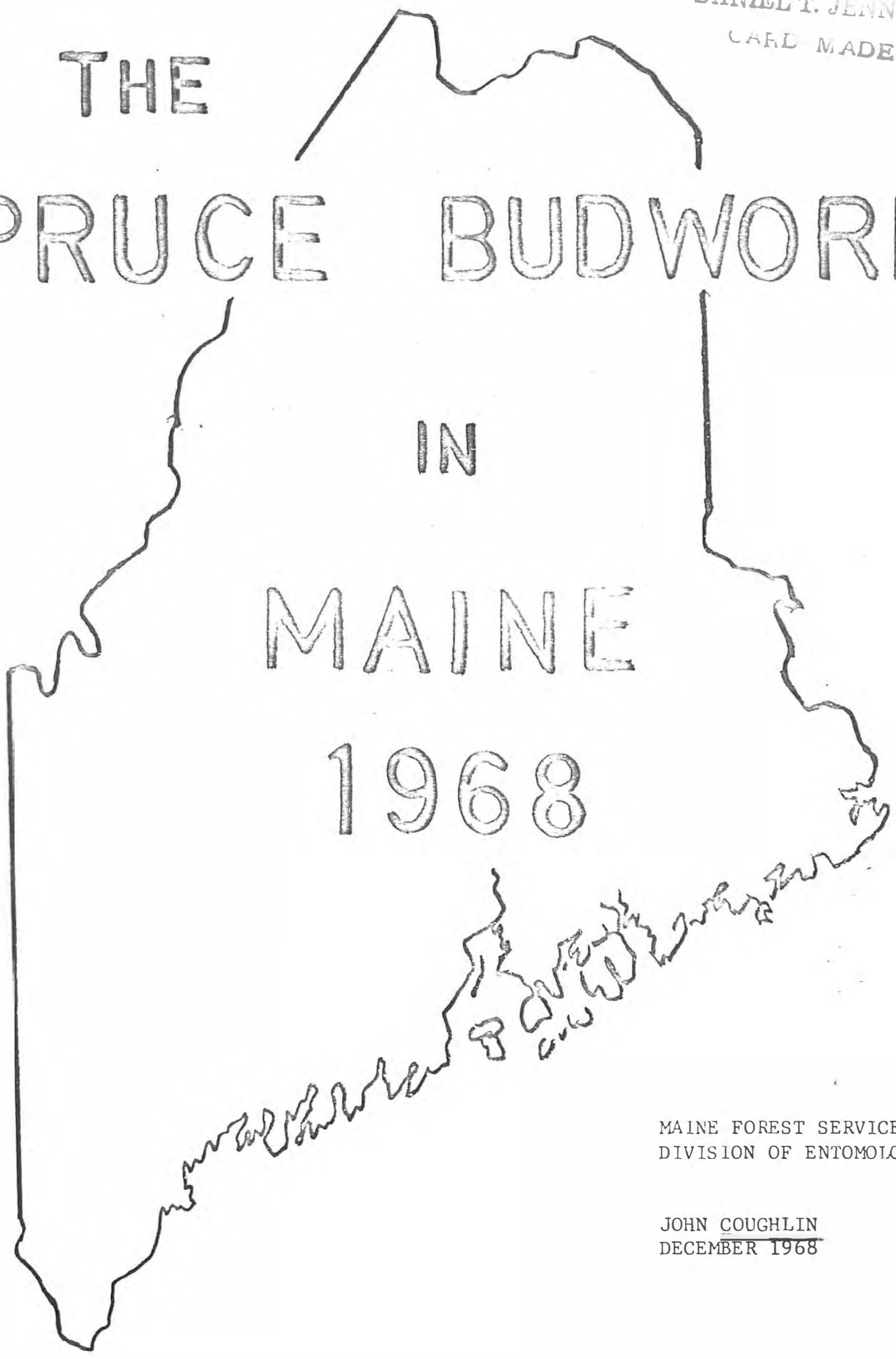
THE SPRUCE BUDWORM IN MAINE 1968



MAINE FOREST SERVICE
DIVISION OF ENTOMOLOGY

JOHN COUGHLIN
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1. INTRODUCTION

The spruce budworm problem in northern Maine continued to demand attention in 1968. Personnel of the Maine Forestry Department spent much of the summer field season on intensive surveys in Aroostook County and northern Piscataquis and Penobscot Counties. Such surveys have been a part of regular work each year since the current budworm epidemic began. Operations were based at the Portage laboratory. This facility was the scene of unusual activity in 1968 in connection with a test of the insecticide SUMITHION by the U. S. Forest Service.

The usual check on budworm development, larval and egg mass surveys, and aerial surveys for defoliation were part of the 1968 work. As needed, primary attention was given to assisting the U.S. Forest Service in their test program. The laboratory phase of their work was centered at Portage, taking advantage of the existing facilities, similarity of the Maine work, and trained technicians available. Other than this test, there were no spray operations in 1968.

Regular Forest Insect Survey tree-beating collections (made by fire control personnel and Forest Insect Rangers) and collections from light trap stations were used to detect possible infestations outside the area covered by personnel assigned specifically to the budworm project. Collections sent to Portage or Augusta from which spruce budworm were recovered are shown in Figure 1.

Involved during 1968 have been entomologists Douglas Stark and Hubbard Trefts, Biologist Gerry Freeman and Forest Insect Rangers James Holmes, Maynard Atwood, Rex McBreairty, James McMullen, Fred Breton, and Lendon Robinson. The work is under the writer's direction. Identification of spruce budworm collected in the Forest Insect Survey and moths caught in light traps have been made at the Augusta laboratory by entomologist Richard Dearborn.

A historical summary of the budworm problem in Maine, some biological notes, and a more detailed description of the work is contained in the 1967 report, copies of which are still available. Earlier reports are also available on request.

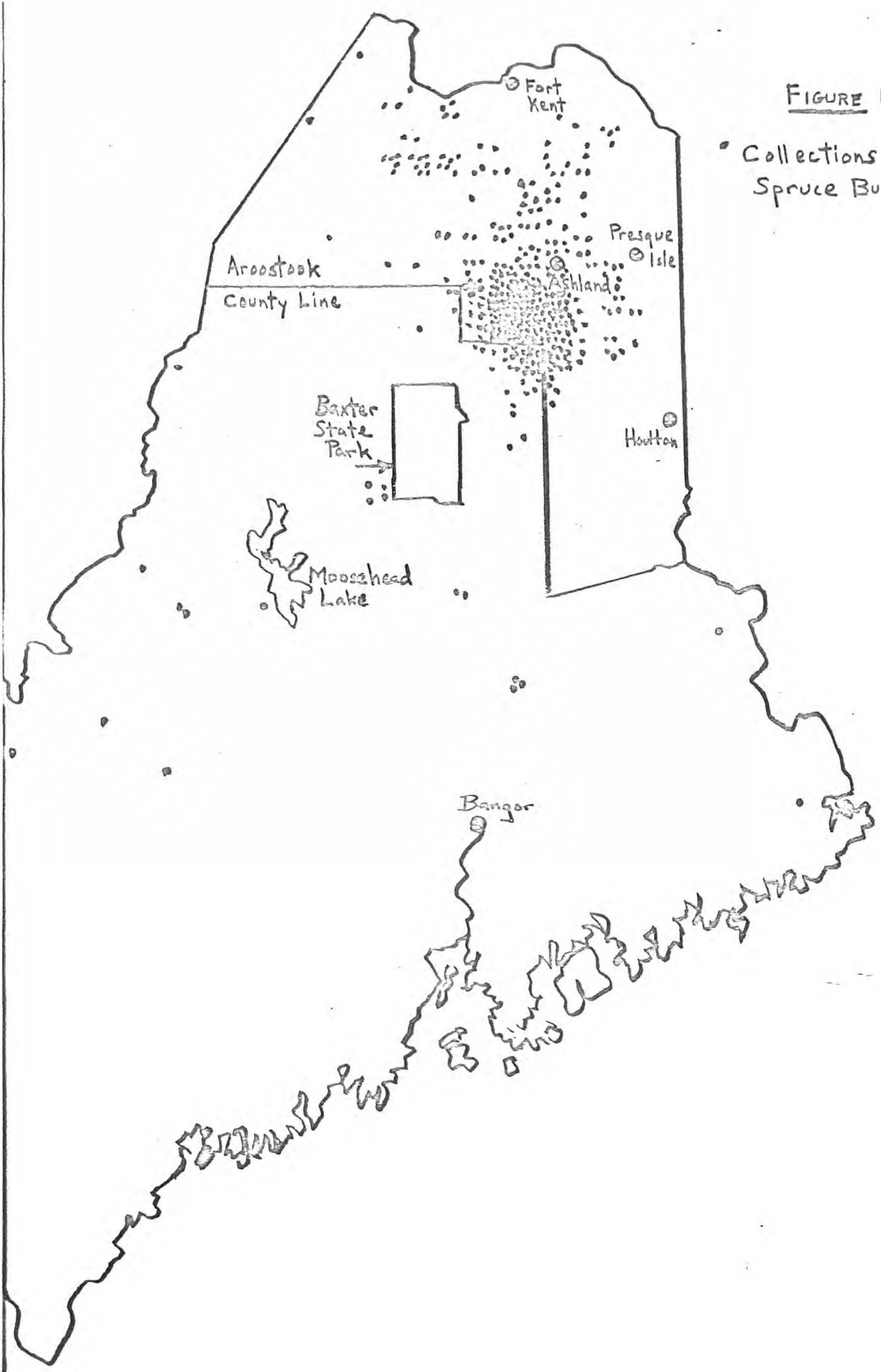


FIGURE 1.

* Collections Yieldi
Spruce Budworm

2. TESTING OF INSECTICIDE SUMITHION

At a meeting of Federal and State entomologists in Augusta during the fall of 1967, it was recommended to try further experimental control operations with the hope that a material could be found to replace DDT. The budworm epidemic, though now confined to the Oxbow area, showed no signs of decline. There was concern not only for the area presently involved but for surrounding areas. There were indications that the infestation might spread into new areas and also back into those areas where control had been achieved. Yet, there was no spray material available to meet this threat.

Various alternatives to DDT had been tried in the past, all without success. Most recent was a test of ZECTRAN, organized and carried out by the U. S. Forest Service in 1967 with disappointing results. The most promising material now appeared to be SUMITHION, an insecticide indicated to have good potential as a result of Canadian work in adjacent New Brunswick. A test of this material was planned for 1968. As in 1967, the test was to be under the control of the U.S. Forest Service.

Personnel of the U.S. Forest Service and the Maine Forestry Department examined potential test sites in the early spring of 1968. Areas were selected largely on the basis of the 1967 egg mass survey to include heavy populations of the budworm. Layout of the test areas on the ground, marking, sampling design, and pre-spray collections were all made by the U.S. Forest Service. The Maine Forestry Department provided laboratory facilities and hired eight additional laboratory workers who received the benefit of working with the regular experienced workers. An experienced supervisor of airport operations during the spray job was also provided by the State. Later, the State was reimbursed for the additional laboratory help and the supervisor.

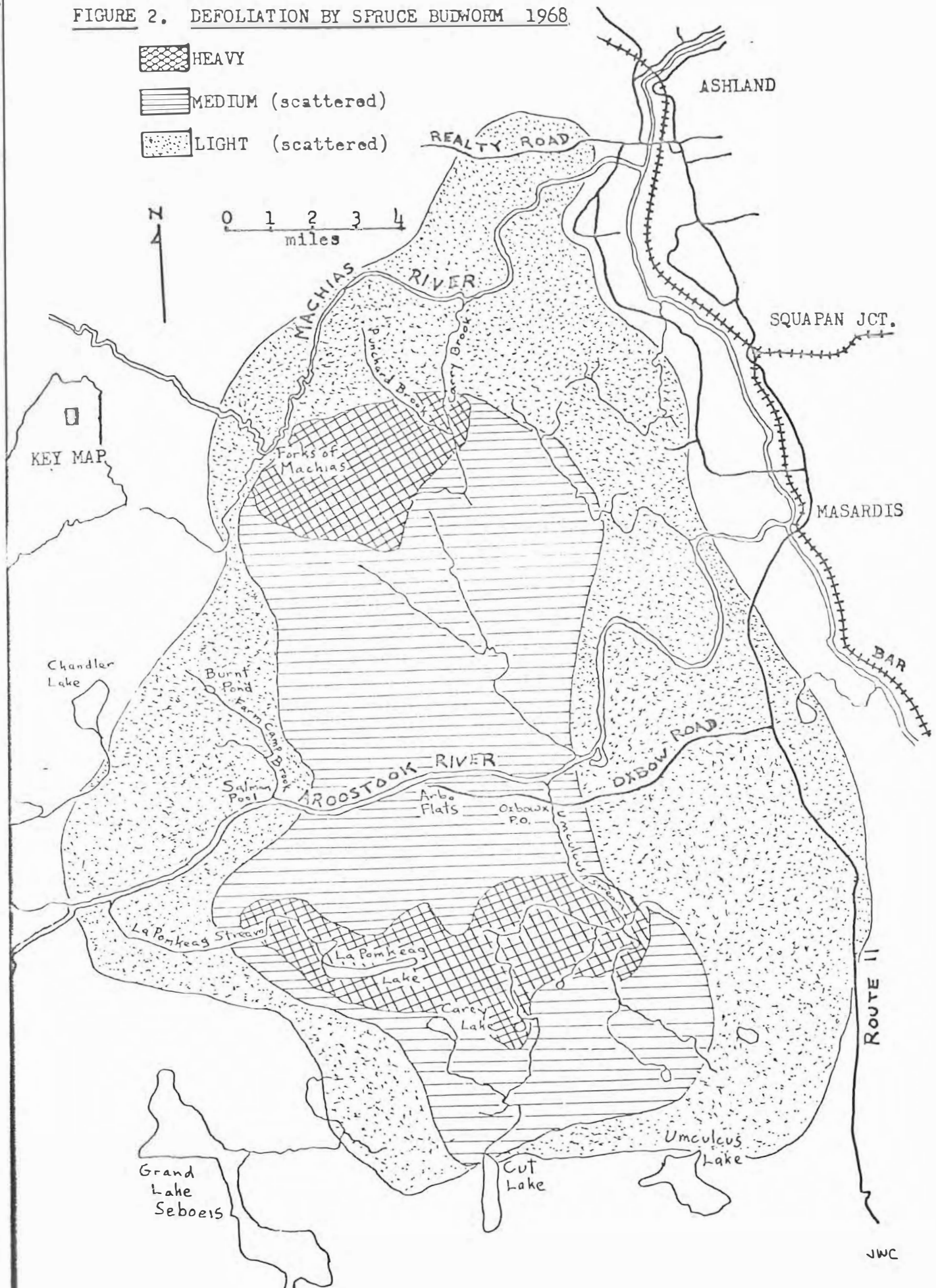
Following the test spray application, both Federal and State workers were used for post-spray sampling and all available laboratory workers were used to process the samples. Raw data were processed by the U. S. Forest Service. Results bore out initial impressions. Control was poor.

Before, during, and after the spray operations, the test areas were examined by other agencies. Reports of the effect of Sumithion on other than the budworm have been made by these agencies and all are included in a detailed report by the U. S. Forest Service.

3. DEFOLIATION BY THE SPRUCE BUDWORM IN 1968

Surveys for defoliation were made from the air and supplemented by ground observations during the egg mass survey. There were increases in both the extent and severity of defoliation between 1967 and 1968. Larger areas were classified both "medium" and "heavy" and the outer boundary of "light-scattered" defoliation has been extended. However, the entire defoliated area is characterized by great variability and the more heavily defoliated areas are intermixed with less seriously damaged areas, hard wood ridges, and more open places. The area is not nearly as uniform as suggested by the map (Figure 2).

FIGURE 2. DEFOLIATION BY SPRUCE BUDWORM 1968



The most extensive areas of defoliation are just east of the Forks of the Machias and along Umculcus Stream westerly past LaPomkeag Lake. Much of this defoliation is recent so that the areas of serious tree condition are quite limited.

As has been the case for several years now, all readily visible defoliation has been in the same general area shown in Figure 2. Although close examination of foliage in other places will often show some signs of budworm feeding, none is heavy enough to be visible from the air.

4. LARVAL AND EGG MASS SURVEYS

Surveys of the spruce budworm population were made during three periods of its seasonal development - twice during the larval stages and once later, after the moths had emerged and deposited the eggs that would make up the 1969 population. The early larval survey beginning in mid-May confirmed last years egg mass survey. Heavy budworm populations were concentrated in the same areas north and south of Oxbow with a very light population scattered elsewhere throughout northern Aroostook County. Collections made at this time also provided a check on the representativeness of special collections made to follow the seasonal development of the budworm (Figure 3). Data from these collections were used by the U.S. Forest Service in timing the Sumithion test. Such data are essential for timing spray applications and are gathered even in non-spray years as background information. As personnel were needed later to pick up post-Sumithion-spray samples, few collection sites were resampled during the later larval-pupal period. Those few sites that were resampled showed the expected, usual, natural mortality.

As in past years, the greatest attention was concentrated on the egg mass survey in order to predict the 1969 situation. With the exception of one "medium to heavy" collection in North Wade, in the potato farming country, all medium or heavy collections came from the area shown in Figure 4. Outlying areas in northern Maine were sampled as in past years but yielded only negligible to light collections. The bulk of the budworm infestation is still confined to the relatively small area of Figure 4, but many outlying sites which in 1967 yielded no budworm egg masses, yielded light samples in 1968. The survey results suggest a considerable dispersion from the infested Oxbow area.

In order to make direct comparisons of 1968 data with that of past years, the designations "heavy population area" and "all other areas" have been retained for Table. 1. Actually these terms are somewhat obsolete as the "heavy population area" of 1965-1967 is now extended on the east and especially on the west in the vicinity of the Forks of the Machias.

FIGURE 3. DEVELOPMENT OF SPRUCE BUDWORM IN 1968

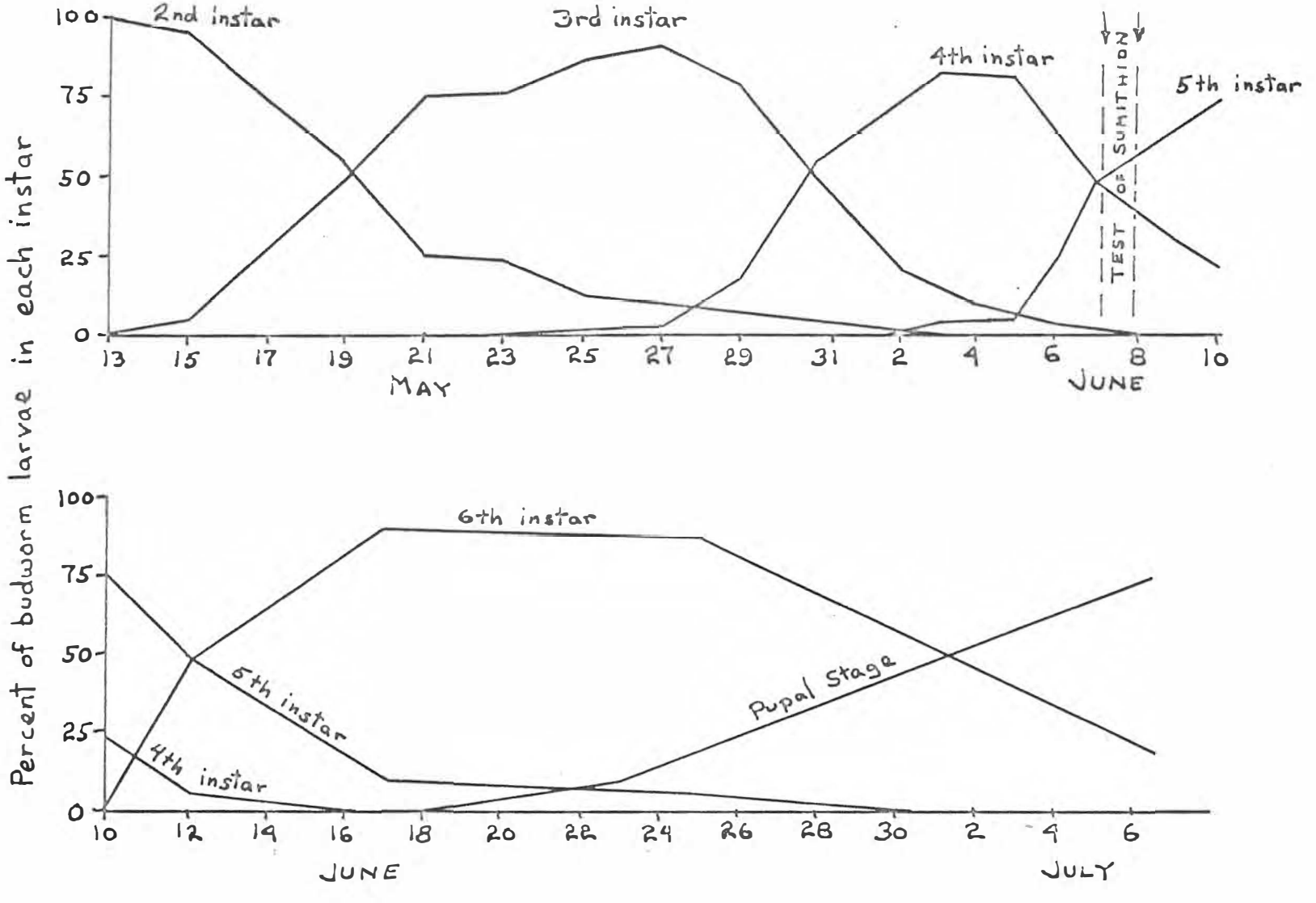


FIGURE 4. EGG MASS SURVEY 1968

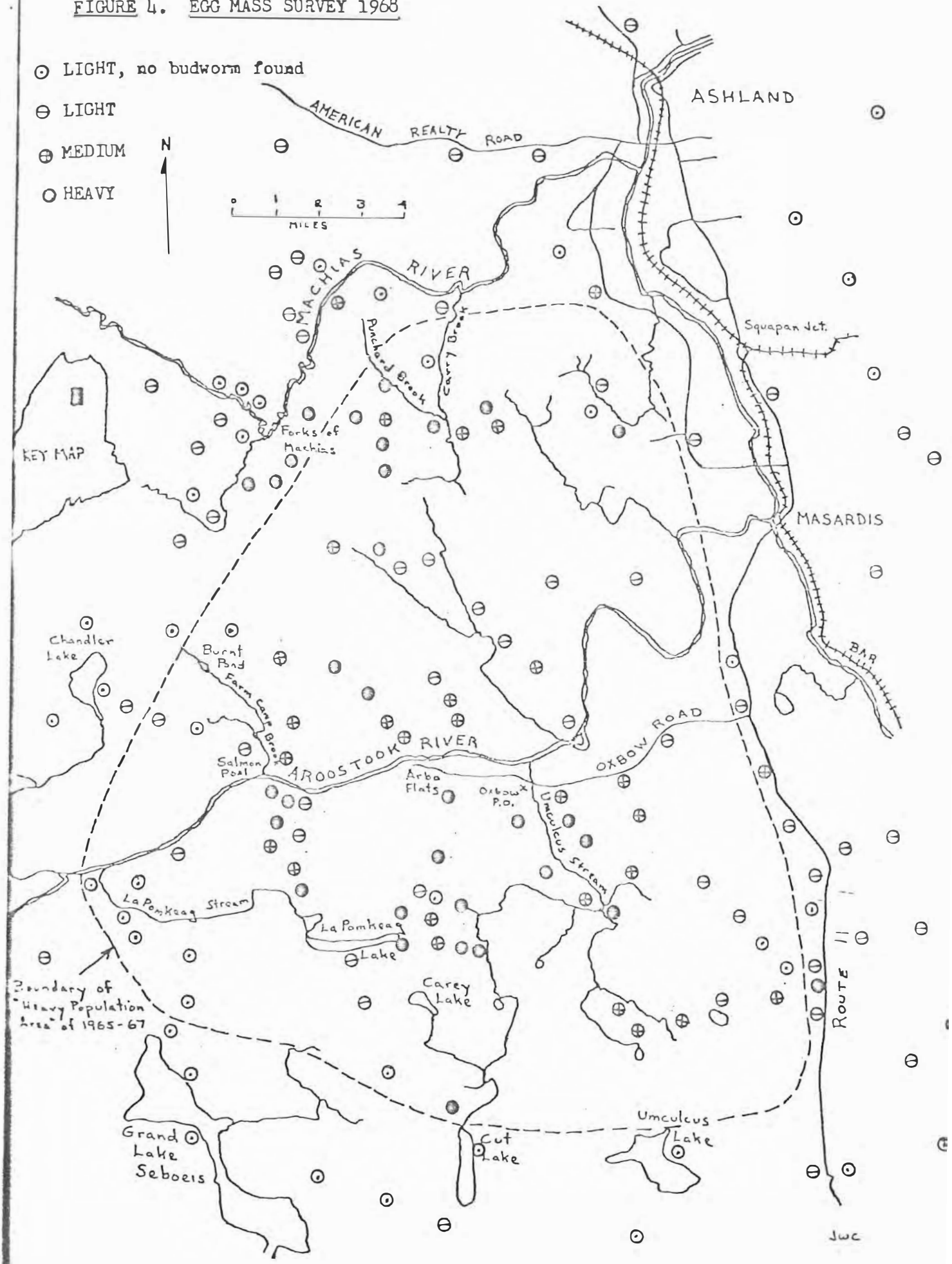


TABLE 1. TRENDS IN SPRUCE BUDWORM EGG MASS POPULATIONS, 1966-1968

Average number of egg masses per 15-inch fir tip sample
(number of sample points indicated in brackets)

	1966	1967	1968
1. Heavy population area[1]	1.011 (77)	.556 (101)	.784 (89)
	(Trend index[2] 0.55)		(Trend index[3] 1.41)
2. All other areas	.015 (239)	.041 (203)	.116 (217)
	(Trend index 2.73)		(Trend index 2.80)
3. All other areas discounting five heavy collections near the heavy population area boundary	... ...	.041 (203)	.066 (212)
			(Trend index 1.61)

TABLE 2. Number of budworm egg masses for various classes of infestation to be expected the following season.

Light	less than .32 per 15-inch balsam fir tip.[4]
Light to Medium ...	from .32/tip to .56/tip.
Medium	from .56/tip to .76/tip.
Medium to Heavy....	from .76/tip to 1.36/tip.
Heavy	over 1.36/tip.

1. This designation is left over from 1965-1967 when the infestation was more easily defined by a definite boundary enclosing what was termed the "heavy population area". The term is retained here for the purpose of comparable data in showing trends within the area.

2. Ratio of 1967/1966

3. Ratio of 1968/1967

4. Sample unit is 5 15-inch tips from each of 5 trees, or 25 tips/collection point, taken with a pole pruner from the mid-crown. However, at the laboratory a sequential counting system makes it unnecessary to search all 25 tips from each sample. The class of infestation may be identified by searching as few as 8 or as many as 25 tips depending on the degree of infestation. The figures are related here to a per tip basis for ready comparison.

Within the "heavy population area", the average number of egg masses per 15-inch fir tip sample decreased from 1.011 in 1966 to .556 in 1967, a result of that year's spray program. The increase to .784 in 1968 indicates a recovery although pre-spray levels have not been reached as yet. The increase in 1968 was in spite of apparent loss of budworm to other areas through dispersion. The figures in themselves do not suggest excessively high populations (See Table 2) but they are averages of extremely variable counts. Of the 89 samples collected from the "heavy population area" in 1968, 14 yielded no egg masses, yet other samples brought the average up so as to show the increase from 1967 to 1968. Eighteen samples were "light", 17 "light to medium", 10 "medium", 19 "medium to heavy", and 11 were "heavy". The highest count recorded was 6.375 egg masses per sample tip. Thus the "heavy population area" includes some truly heavy populations not revealed by Table 1. Much of the variation in this area results from the 1967 DDT spray operation which left irregularly placed pockets of heavy budworm populations intermixed with light to negligible populations.

Four "heavy" egg mass collections were made just outside the "heavy population area" boundary near the Forks of the Machias. These, together with a fifth "heavy" collection to the east account for much of the increase in the otherwise lightly populated "All other areas" of Table 1. In these areas the average number of budworm egg masses per sample 15-inch fir tip increased from .041 in 1967 to .116 in 1968, continuing an upward trend. If the five "heavy" collections just outside the "heavy population area" are discounted, then the increase is only from .041 to .066. However, this 1968 increase, representing all areas of northern Maine except the "heavy population area" of Oxbow, bears out observations of field workers who noted that many collection sites far removed from the infested Oxbow area yielded more egg masses in 1968 than in 1967.

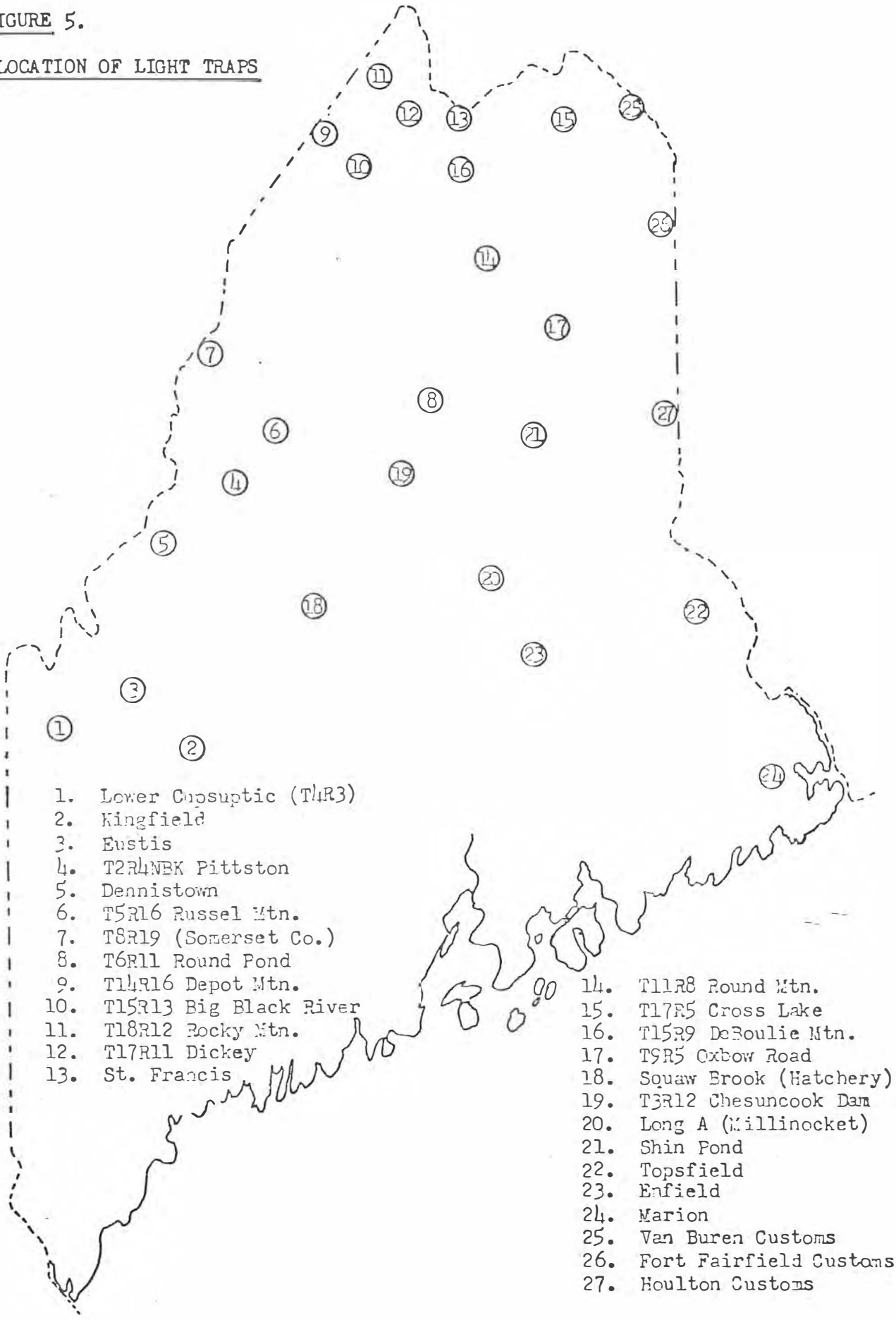
In general, the larval and egg mass surveys indicate that the epidemic spruce budworm infestation is still confined to the relatively limited area around Oxbow. The infestation increased in 1965 and 1966, was set back by the 1967 spray operation, and has again increased in 1968. The surveys also show a small but significant upward trend throughout northern Maine especially near the heavily infested Oxbow area.

5. SPRUCE BUDWORM MOTHS AT LIGHT TRAPS IN 1968

Light traps are set up and operated each year at various points throughout the spruce-fir region of the state. Their primary purpose has been to detect flights and infestations of the budworm. The locations of these traps are shown in Figure 5. Three of the locations, nos. 25,26, and 27 are not actual traps but U.S. Customs stations where the all-night lights attract many kinds of insects. Results of the 1968 light trap operation are summarized in Table 3. For the second successive year, increased budworm activity was indicated. Western Maine locations such as traps 1 (Lower Cupsuptic) and 5 (Dennistown) are showing increased catches. Increasing numbers of moths in the Aroostook County traps such as 12 (Dickey), 15 (Cross Lake), 16 (DeBoullie) and especially 17 (Oxbow Road) are to be expected in view of the active Oxbow infestation. It was surprising to find the high numbers at 20 (Millinocket), 22 (Topsfield), 24 (Marion) and especially 23 (Enfield). There has been little sign of spruce budworm in these areas in recent years but the 1968 surveys indicate a need for increased detection and survey work for 1969.

FIGURE 5.

LOCATION OF LIGHT TRAPS



1. Lower Cupsuptic (T4R3)
2. Kingfield
3. Eustis
4. T2R4NBK Pittston
5. Dennistown
6. T5R16 Russel Mtn.
7. T8R19 (Somerset Co.)
8. T6R11 Round Pond
9. T14R16 Depot Mtn.
10. T15R13 Big Black River
11. T18R12 Rocky Mtn.
12. T17R11 Dickey
13. St. Francis
14. T11R8 Round Mtn.
15. T17R5 Cross Lake
16. T15R9 DeBoulie Mtn.
17. T9R5 Oxbow Road
18. Squaw Brook (Hatchery)
19. T3R12 Chesuncook Dam
20. Long A (Millinocket)
21. Shin Pond
22. Topsfield
23. Enfield
24. Marion
25. Van Buren Customs
26. Fort Fairfield Customs
27. Houlton Customs

	JULY												DATES OF COLLECTIONS*																	AUGUST		
LIGHT TRAP	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	4	TOTAL
1	3	6	4	11	1	3	1		1					5		4	3	2	2	3	2		1	1		1				1		55
2		1											2	2?		1?	3?				1		1									11
3													1	2?		4	1			1												9
4																																0
5					1		5		3				1	4		5			1													20
6																																0
7							4							2		2	2						1?									11
8													1	2		1							1									5
9														1	1		1															3
10																																0
11														4	1	3		1														9
12											2						16	2	1		1			1		1						24
13																		2?	1					1			2	1	1			8
14													1	2	3	2	3	1	1													13
15																65	21	7	1			1				1						96
16							1			1		2	12	3	9	27							11	1	3	2					1	73
17								1	6	1	6	3	9	76	52	28	17	24	1		1	2	1									228
18													1	1	7	1	4															14
19					2		1			3		1		1	1	2																11
20	1	31	1	3								5	4	18	12	17	2	1														95
21													5	2		3			3													13
22								1					21		4	17	6															49
23				1	1	1	6			2	2		2	20	62	32	11	6	7	3	3	3	1		1					2		166
24								2			2	4	4	7	2	5	1		5	2		1										35
25																																0
26																																0
27																																0
TOTALS:	4	38	5	15	5	4	18	4	10	7	12	15	64	152	154	219	91	46	23	9	8	7	17	4	4	5	2	1	1	3	1	948

*For example, July 10 means the night of July 9-10

6. NATURAL CONTROL FACTORS

The year 1968 seemed in general to be a favorable one for the spruce budworm in Maine. Weather was favorable during the larval development which proceeded in a regular and routine manner (Figure 3).

Parasites of the early larval stage and of the late larval-pupal stage were checked routinely as in past years by dissection and rearing at the Portage laboratory. Budworm parasitism during the early larval stage was similar to that in 1967. Parasitism during the later stages was not as closely checked since few survey collections were made at this time, emphasis being given to the post-Sumithion-spray checks. As in past years, nearly all data came from the heavily infested area and continued to indicate little effect of these natural agents on the epidemic conditions. Too few budworm have been recovered from the outlying, lightly populated areas to give any reliable estimates of parasitism under endemic conditions. In these areas, parasites may be more effective but no data are available to demonstrate it.

Egg mass parasitism continued to be low, varying from 5.9% in the lightly populated areas to 3.4% around the heavily populated Oxbow area.

A summary of the 1968 parasitism checks is contained in Table. 4.

7. EXPECTED 1969 CONDITIONS

The spruce budworm infestation can be expected to continue and probably intensify in the Oxbow area during 1969, given favorable weather conditions for the insect. The heavily infested area can be expected to enlarge as it did in 1968 and there will probably be considerable dispersion loss from this area to more lightly infested areas throughout northern Maine. Whether these lightly infested areas will reach the epidemic conditions of the past no one can say but the apparent spread, out from the Oxbow area, in 1968, indicates the threat presented by this active, unchecked infestation.

During December of 1968, Federal and State entomologists and industry representatives met in Augusta to discuss the budworm situation and make recommendations. Since no insecticide is yet operational to replace DDT for budworm control in the northeastern U.S., the threat is serious. There was considerable interest in further work with Zectran and in closer contact with the Canadian Sumithion work. Further testing and study was recommended.

Fortunately the areas of critical tree condition are not yet large. There would still seem to be time to work out a control method before the infestation reaches the critical stage over the extensive areas involved in past years.

TABLE 4. PARASITISM OF THE SPRUCE BUDWORM IN MAINE IN 1968

A. Early Larval Parasitism

No. of collections	94
No. of larvae dissected	2852
No. of *Apanteles* sp. recovered	189
" " *Glypta* " "	118
" " *Horogenes* " "	38
" " unidentified parasites	2
Total no. of parasites	347
Percent parasitized	12.2
	(12.5 in 1967)

B. Late larval-pupal parasitism

No. of collections	10 (only)
Corrected number of larvae and pupae reared	579
Parasite genera recovered:	
Ephialtes	22
Phaeogenes	1
Meteorus	5
Actia	5
Aplomya	10
Lypha	13
Omotoma	2
Phryxe	24
Total no. of parasites	82
Percent of those reared parasitized:	14.2
	(10.25 in 1967)

C. Egg masses showing parasitism

Of egg masses collected from lightly infested areas, 5.9% showed parasitism.

Of egg masses in and around the Oxbow area, 3.4% showed parasitism.

8. SUMMARY

1. As a possible substitute for DDT in spruce budworm control the insecticide SUMITHION was tested in northern Maine by the U. S. Forest Service. Pre- and Post-spray budworm samples taken from the test area indicated poor control.

2. The Oxbow area infestation continued with defoliation in the same general area becoming more severe with a moderate increase in the size of the infested area.

3. Ground surveys indicated an increase in budworm numbers within the most seriously infested areas and an outward spread into surrounding areas. The surveys also indicated a rising trend throughout northern Maine.

4. Given favorable weather conditions, the budworm infestation is expected to increase in both size and intensity during 1969.

5. No insecticide is yet operational to replace DDT in budworm control in the northeastern U.S. but further experimental work has been recommended for 1969.